Nano MOX chemical sensors applied to agri-food field

G. Sberveglieri, (1,*), E. Comini, (1,2), M. Abbatangelo (1,2), G. Duina (1,2) , E. Nunez Carmona (3), and V. Sberveglieri (1,3)

(1) NANO SENSOR SYSTEMS SRL, Innovative Start-up, Via C. Brozzoni, 9, 25125 Brescia (BS) Italy
(2) SENSOR Lab, University of Brescia, Via Branze, 38, 25122 Brescia (BS), Italy
(3) CNR – IBBR, Via Madonna del Piano 10, 50019 Sesto Fiorentino (FI) Italy
(*) corresponding author: giorgio.sbverveglieri@nasys.it

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1. SUMMARY:

Current chemical, physical and microbiological techniques employed for the quality control process in the food production chain are extremely reliable but in the major of cases require the use of high-trained lab staff, costly equipment and are time consuming. New and innovative technologies have been developed thanks to the progress in nanotechnology. Chemical sensors based on metal oxides semiconductors with the nanowires have been proven to be the most promising as gas sensors thanks to low-cost fabrication processes, simple preparation and operation and easily applicability to the food control. In this presentation, we will show the synthesis of MOX Nano Wires using different low-cost buttom up nano-technologies of the down up type. it will also show an innovative Electronic Nose, called S3, based on NWs and connected in the cloud for a complex but rapid and efficient data analysis will be presented.

2. MOTIVATION and RESULTS:

Food production in the world is evolving, as the consumer is also evolving very quickly. Today, consumers are much more attentive and informed, therefore they require more information on the origin, the authenticity and quality of the foods they buy. Therefore, they seek greater guarantees on the food they buy every day.

Although we are living in a time when food technologies and controls are at the highest levels, this is not enough. Indeed, the main cause of hospitalization in developed countries is related to food poisoning.

The World Health Organization reports as statistics that 1 in 10 people get sick every year by eating contaminated food and 420,000 people die each year as a result [1-2].

Therefore, feels the great need to develop techniques, economic, fast and easy to use to reduce the source of contamination and to provide real-time information on the foods you are eating. One of the most promising techniques, shown in this presentation by MOX nanowire gas sensors incorporated as arrays in the portable device, Small Sensor System (S3), able to evaluate quality, authenticity, geographical origin and safety of food through the VOC analysis.

Many of the applications of the S3 have been carried out by a system of 6 MOX gas sensors inside produced by Nano Sensor Systems srl (www.nasys.it, Spin-off of the University of Brescia). Three of these were MOX nanowires (two tin oxide nanowire sensors with gold growth catalyst and one with additional gold clusters on the top of the nanowires, the third one copper oxide nanowires). The other three sensors were

prepared with thin film with Rheotaxial Growth and Thermal Oxidation (RGTO) one functionalized with a cluster of gold, two pure tin oxide.

The S3 (Small Sensor System) (fig.1) has been successfully applied in the food sector for the determination of frauds, for the control of geographical origins, for possible chemical and physical contamination, and also for monitoring cooking and storage processes in the ovens and refrigerators. In fact the device, called S3, easily adapts and provides rapid results even when working at low or high temperatures, easily combining food production and transformation processes [3].

The versatility and accuracy of the S3 are due to several factors that make it a real tailor-made device, in the forefront in the development of customized nano-sensors (for example by modifying the growth parameters and / or surface catalysts) for specific application. The sensors applied with remarkable success in our device have grown, developed and characterized entirely in our laboratories, thus guaranteeing perfect applicability to very different situations [4-6].

The second factor that contributes to its versatility is closely linked to its ability to connect via wifi to its own Web app, developed by NASYS Srl, which can make the device and its use user-friendly.

Users can set measurement sessions, see all the measurements that have been made divided into different projects, graphical graphs of sensor responses, perform multivariate statistical analyzes such as principal component analysis (PCA) and train artificial neural networks (ANN) and more generally NASYS proprietary algorithms for classification purposes.

3. FIGURE:

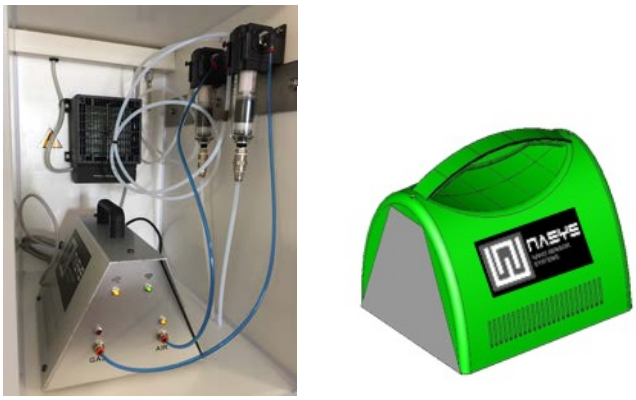

Fig. 1: S3 for wastewater detection on line (Left) S3 Small Sensor Systems device (right).

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